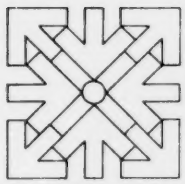
Ontario
Waste Management
Corporation
System
Development
Project



The Proctor & Redfern Group

Technical Proposal

Generic Process Technologies Study

Ontario
Waste Management
Corporation
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GENERIC PROCESS TECHNOLOGIES STUDY:

TECHNICAL PROPOSAL

PROCTOR & REDFERN LIMITED
ONTARIO RESEARCH FOUNDATION
WESTON DESIGNERS-CONSULTANTS

JANUARY 1982

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1.0 INTRODUCTION

An effective approach to provincial waste management will require the application of a wide range of pre-treatment, recovery, reduction, treatment and destruction processes prior to final disposal of residues from these processes. The application of these processes should achieve the following:

- Recover a significant quantity of materials for re-use
- Reduce total quantities of material for disposal
- Enhance the characteristics of the wastes destined for proper disposal
- Reduce handling and disposal hazards
- Reduce total disposal costs
- Reduce transportation costs
- Optimize overall environmental benefits

A total systems approach requires optimization of waste management processes to balance the requirements for waste reduction and utilization, resource recovery, handling, exchange, processing and treatment, and ultimate disposal. The total provincial system must be considered particularly as it affects the scale and integration of pretreatment processes. If a network of regional pretreatment and transfer stations were established throughout the province, the needs of these facilities in terms of the type and scale of treatment systems could be quite different from treating all wastes at a central facility.

In general terms, waste management technology which will be considered in this task can be broadly categorized as follows:

- At source technical processes, controls, abatement, recycling, recovery, and reuse/exchange
- Physical, chemical and biological waste treatment
- Thermal processing and destruction
- Ultimate disposal methods

The main objective to this task is to identify and evaluate, on a non-site specific basis, generic waste management processes to determine technical, cost and environmental effectiveness. Accordingly, this study will restrict itself only to the consideration of generic process technologies and will not review in any detail technology vendors supplying particular processes.

2.0 TECHNICAL PROPOSAL

Those activities to be undertaken in this study include:

Activity 1	Briefing session with the Waste Quantities Study project team to review available reports and information on liquid industrial waste and hazardous waste streams in Ontario.
Activity 2	Identify and inventory waste management technologies and processes.
Activity 3	Evaluate the technical, environmental and cost effective aspects of each waste management process.
Activity 4	Refine information concerning sources, quantities and characteristics of liquid industial waste and hazardous waste streams.
Activity 5	Select primary generic waste management processes which have the highest potential for application in the Province of Ontario.
Activity 6	Establish a framework for application of candidate technologies to a total systems approach in Ontario.
Activity 7	Draft and Final Report

2.1 ACTIVITY 1 - BRIEFING SESSION AND INFORMATION REVIEW

A general understanding of work undertaken to date in Ontario is required to initiate the study. Therefore, preliminary data collected in the early stages of the Waste Quantities Study will be reviewed with that Project Team.

2.2 ACTIVITY 2 - IDENTIFY WASTE MANAGEMENT TECHNOLOGIES

A generic review of waste management technology will be performed. Sources of information for this evaluation will include:

1. Identification of waste management technologies in Canada, United States, Europe, and Japan by generic categories.

2. Current commercial applications of generic technologies in industry.

3. Research and development activity in the waste management field and industrial sectors in Canada,

United States, Europe and Japan.

The process technologies will be inventoried by detailed functional categories as follows:

- Processes for waste abatement
- Processes for recycle and resource recovery
- Physical-chemical treatment
- Biological treatment
- Thermal processing and destruction
- Solidification
- Ultimate disposal

Table 1 (Appendix A), provides a preliminary list of candidate generic waste treatment technologies that will be considered. The product of this step will be a capsule report on these processes which can be readily utilized in the evaluation phase. Each process will be defined in common terms with advantages and disadvantages described relative to other processes, especially those in the same category. Proper references to more detailed information will be provided. Other information provided in matrix form will be as follows:

- Process design considerations
- Type of waste accepted (influent)
- Type of effluents and residuals generated including their characteristics (eg. pH, toxicity, stability, etc.)
- Material and energy requirements
- Development stage
- Example applications to date in waste management or other related industry
- Comment on the commercial potential of example pilot, demonstration or research and development projects
- Environmental parameters and requirements

- Relative economics and costs
- Minimum economic size of process

2.3 ACTIVITY 3 - EVALUATION OF GENERIC PROCESS TECHNOLOGIES

The processes identified in Activity 2 will be evaluated and screened to determine the potential applicability of generic process technologies to treat liquid industrial waste and hazardous waste in Ontario. A set of factors will be developed for evaluating each process, among these will be the following:

- Applicability to a primary waste stream (eg. waste sulfuric acid) or residual (eg. neutralized acid waste) that is being currently or could be potentially generated in the Province of Ontario.
- Technical feasibility, and demonstrability in waste management or similar applications.
- Operational considerations and realiability.
- Availability of full scale units.
- Environmental adequacy, acceptability and secondary impact (eg. air, water, and land use).
- Economic considerations (both investment and unit cost).
- Technology application with regard to existing and future regulations.

The results of the evaluation will be in a matrix form that displays the processes evaluated suitable for presentation by major category and relative assessment against the evaluation factors. The outcome of this evaluation will be a qualitative evaluation of the processes with respect to their potential application in the Province of Ontario.

2.4 ACTIVITY 4 - REFINE WASTE QUANTITY DATA

A Waste Quantities Study is being undertaken in a time frame which parallels the proposed timing of the Generic Process Technologies Study. The Waste Quantities Study will determine the quantity, types and sources of liquid industrial waste and hazardous waste generated in the Province of Ontario.

Close liaison with the Waste Quantities Study Project Team will be necessary throughout this study in order that waste quantity data can be refined prior to submission of a final report. Input from the Waste Quantities Study will be used to refine data for the study

prior to Activity 5 and again prior to Activity 6.

2.5 ACTIVITY 5 - SELECT PRIMARY GENERIC PROCESSES

The purpose of this step is to reduce the number of identified potential generic waste management processes to those most appropriate to deal with the wastes generated in the Province of Ontario. This will be achieved through the following:

- The results of the technical, environmental and economic evaluation factors as discussed in the previous step.
- The experience and professional judgement of the project team and consultants.
- The compatibility of a generic technology with the overall objectives of the Ontario Waste Management Corporation and with existing and future regulations.

A progress report will be prepared during Activity 5. This report will include; the capsule report on process technologies prepared in Activity 2, the matrix evaluation of process technologies in Activity 3 and the rationale to be used in Activity 5. Following the distribution of the progress report the final evaluation and selection of potential primary process technologies can be discussed with OWMC staff, the Core Staff and the Project Team.

2.6 ACTIVITY 6 - FRAMEWORK FOR APPLICATION IN ONTARIO

The objective of the activity is to prepare an Implementation Framework of generic process technologies that could be implemented as part of the waste management system in Ontario. It is anticipated that selection of appropriate candidate process technologies will result in the following:

- Waste elimination, reduction, recovery and reuse processes.
- Pretreatment to reduce volume or improve waste properties to reduce cost of hauling, transportation, and disposal.
- Optimization of overall environmental benefits, public and regulatory agency acceptance.

The Implementation Framework will include:

- The potential for implementing candidate technologies in the Province of Ontario.
- The impact of implementing process technologies in the waste management system.
- Sensitivity and trade-offs pertaining to implementation of each process technology.
- Environmental implications and potential impacts.
- Economic and cost implications.
- Input to the systems approach task.

2.7 ACTIVITY 7 - DRAFT AND FINAL REPORT

A draft final report (12 copies) will be prepared for review and comment by the OWMC staff and Core Staff members. Following this review the draft report will be edited within two weeks after receipt of comments. One camera ready copy and 40 copies of the final report will be submitted.

3.0 PROJECT TEAM

3.1 PROJECT ORGANIZATION

Mr. W.D. Goodings, P.Eng. will supervise the project team, providing policy guidance and be responsible to the client for the successful completion of this assignment. Under Mr. Goodings' guidance, the Task Director will supervise the day to day operation of the project team.

Figure 1 outlines the project team.

3.2 TEAM MEMBERS

Dr. Robert Pojasek has been assigned as Task Director for this study. Dr. Pojasek is a world recognized authority on waste management technology. He is the editor of a six volume treatise on Toxic and Hazardous Waste Disposal, which is regarded as a work of major importance in this field. Dr. Pojasek is presently Vice-President and Technical Director of Weston Designers-Consultants.

Dr. Amir Metry, P.Eng. is the designated Task Manager for the Generic Process Technologies Task. Dr. Metry, Vice-President with Weston Designers-Consultants has been involved in numerous hazardous waste management research and physical siting projects. He has over eighteen years experience in this field and specializes in the treatment and disposal of liquid industrial waste and hazardous waste.

Dr. Robert Laughlin, P.Eng. Assistant Director, Department of Environmental Chemistry, Ontario Research Foundation will be responsible for the review and evaluation of Canadian state-of-the-art treatment and disposal methods especially in the area of reuse and recycle. Dr. Laughlin is presently Director of the Canadian Waste Materials Exchange program.

Matthew McKim, P.Eng. is a chemical and environmental engineer with the Ontario Research Foundation. He has particular interest in the biological treatment of liquid industrial waste and hazardous waste and will be assigned to review these processes.

Michael Corbin, P.Eng.	is a senior engineer with Weston Designers-Consultants. Mr. Corbin who has experience in several studies throughout the United States will lend his experience in the identification and evaluation aspects of this study.

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FIGURE I: PROJECT TEAM

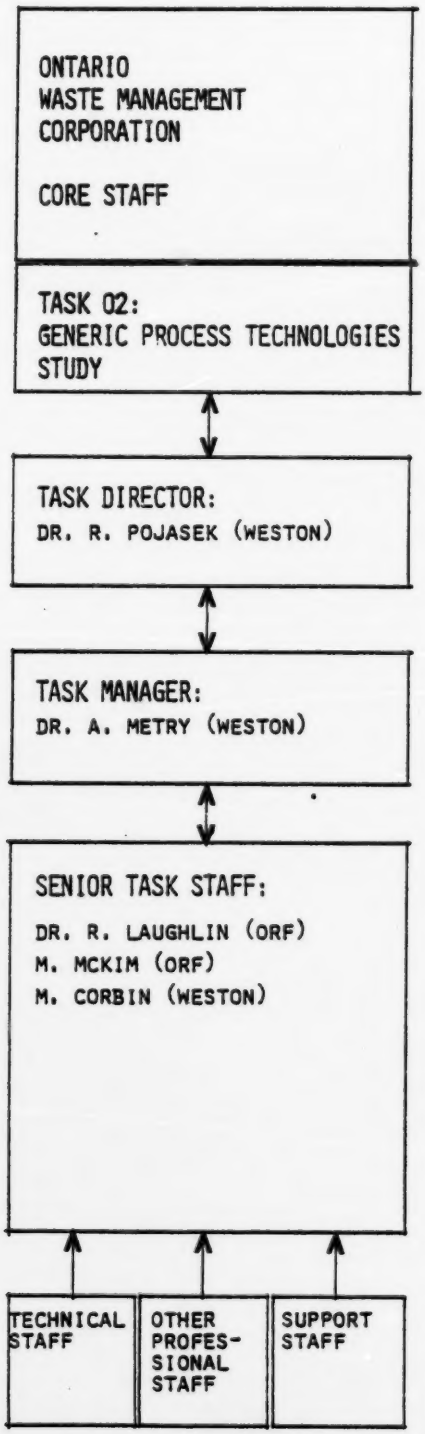

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TABLE 1

SAMPLE LISTING OF CANDIDATE GENERIC WASTE MANAGEMENT TECHNOLOGIES

Waste Abatement Processes	- Use of low-waste and nonwaste technology - Housekeeping to avoid waste contamination - Reuse as raw material - Recycling in production process	
Recycle and Resource Recovery Processes	- Waste Exchange - Blending for use as fuel - Acid recovery - Metal recovery - Solvent refining and recovery - Stripping	- Container recycling - Waste oil refining - Zone refining - Solvent extraction - Distillation - Crystallization
Physical - Chemical Treatment	- Neutralization - Hydrolysis - Reduction - Precipation - Evaporation - Dechlorination - Oxidation - Stripping - Ion Exchange - Liquid Ion Exchange - High Energy Electron Beam - High Gradient Magnetic Separation	- Electrophoresis - Freeze drying - Freeze crystallization - Chlorinalysis - Catalysis - Photolysis - Electrolysis - Dewatering - Membrane technology - Thickening - Emulsion breaking - Absorption Techniques
Biological Treatment	- Activated sludge - Aerated lagoons - Anaerobic digestion - Composting - Enzyme treatment - Trickling filter - Rotating biological disc	- Waste stab. ponds - Mutant bacteria - Deep shaft aeration - Fluidized bed bioreactor - Powder activated carbon land farming - Land farming - spray irrigation - Municipal sewage treatment plants

Thermal Processing and Destruction	- Rotary kiln - Fluidized bed - Molten salt - Plasma arc - Cement kiln - Microwave plasma discharge - Multiple hearth - Pyrolysis	- Liquid injection - Vertical tube reactor - Infrared furnace - Co-incineration - Shipboard incineration - Evaporation - Calcination - Wet air oxidation
Solidification	- Silica-cement - Lime-base - Thermoplastic - Organic Polymer	- Ceramic - Glassification - Encapsulation
Ultimate Disposal	- Secure landfill - Engineered landfill - Structural landfill - Deep well injection - Ocean Disposal - Geologic isolation	- Seabed implacement - Aboveground storage - Codisposal - Lagoons and impoundments - Land farming

Robert B. Pojasek, Ph.D

Fields of Competence

Development of hazardous waste management programs; evaluation of waste treatment/disposal options; analytical chemistry protocol development for wastes and waste site investigations; design of laboratory quality assurance programs; detection and removal of toxic (priority) pollutants in wastewaters; siting controversial facilities; regulatory compliance evaluations.

Experience Summary

Ten years experience in the environmental chemistry field as problem solver on multidisciplinary teams concerned with environmental engineering, assessment and research activities. Has been involved in set-up, supervision, and quality assurance of laboratory analysis, field monitoring, and R&D activities. Many of these activities have involved the management of hazardous chemical wastes. Also involved in wastewater technology assessment and mechanisms involved in drinking water quality degradation in surface and groundwater supplies and distribution systems.

Credentials

B.S. Chemistry—Rutgers University

Ph.D. Chemistry—University of Massachusetts

American Chemical Society
Committee on Environmental Improvement
Division of Environmental Chemistry, Executive Board

Water Pollution Control Federation
Standard Methods Committee

New England Water Pollution Control Association
Industrial Wastewater Committee

American Society for Testing and Materials
D34-Waste Disposal Committee

Sigma Xi

Office of Science and Technology Policy
Consultant (Executive Office of the President)

Massachusetts Hazardous Waste Advisory Committee

World Health Organization
Consultant, Regional Office for Europe

Employment History

1980-Present	WESTON
1977-1980	ERCO Cambridge, Massachusetts Laboratory Director, Hazardous Waste Consultant
1975-1977	JBF Scientific Corporation Wilmington, Massachusetts Laboratory Director, Senior Environmental Chemist
1973-1975	Lawler, Matusky and Skelly Engineers Pearl River, New York Laboratory Director Senior Staff Chemist
1971-1973	New England Research, Inc. Worchester, Massachusetts Consultant

Key Projects

Filing exemption petitions to EPA to declassify hazardous wastes.

Investigations of groundwater contamination related to hazardous waste mismanagement and spills

Characterization of toxic pollutants from industrial discharges.

Development of an analytical protocol to analyze toxic metals and organics in municipal and industrial sludges by eliminating complicated matrix effects.

Development of analytical protocols to evaluate the leachability of toxic constituents from spilled or landfilled chemical wastes.

Hazardous waste characterization for an EPA study of the economic impact analysis of RCRA legislation on seven selected industries.

Conceptual design of hazardous waste management facilities.

Direction of a specialty analytical facility with over $2 million of projects in its organics, microbiology, and trace metals departments.

Professional Profile

Amir A. Metry
Ph.D., P.E.

Registration

Registered Professional Engineer in the States of Pennsylvania and Maryland.

Fields of Competence

Engineering management; project management; water and wastewater facilities design; hazardous/solid waste management; coal residuals management; air pollution control studies and system design; environmental assessment and resources management; environmental modeling and simulation.

Experience Summary

Eighteen years experience in various environmental fields as project manager, project engineer, research associate, department manager, and principal with national and international engineering firms.

Conceptual design of stabilization facilities and land disposal facilities for chemical, waste management, and utility industries. Manager of studies involving 208 planning; environmental assessment; solid waste management plans for municipal governments; air pollution studies and system designs; stack sampling and odor control for petroleum, glass, chemical, and food industries; development of hazardous/solid waste management plans; design and construction management for water and wastewater treatment facilities for industry, government, and international firms and governments.

Credentials

B.S. Mechanical Engineering—Cairo University (1963)

M.S. Engineering Management—Cairo University (1967)

M.S. Environmental Engineering—Drexel University (1969)

Ph.D. Environmental Engineering—Drexel University (1972)

American Society of Civil Engineers

National Society of Professional Engineers

Water Pollution Control Federation

Water Pollution Control Association of Pennsylvania

Institute of Environmental Sciences

Diplomate of the American Academy of Environmental Engineers

Employment History

1981-Present	WESTON
1978-1981	IU Conversion Systems, Inc. Vice President, Research and Concept Engineering
1973-1978	WESTON
1968-1973	Drexel University Research Associate
1963-1968	Naim Mahfouz Engineering Cairo, Egypt Project Engineer

Key Projects

Planning, siting, and conceptual design of a regional sludge handling, stabilization, and land disposal facility for Envirosafe Services, Inc., Horsham, Pennsylvania.

Evaluation and conceptual design of demonstration facility for chemical stabilization and secure landfilling of chromate residuals for a confidential client.

Process development, conceptual design, operations assistance, and geotechnical engineering for handling, stabilization, and land disposal of flue gas cleaning residuals for 10 major electric power utilities.

Conducted a study on impact and potential of coal utilization on the environmental services industry. Recommended approaches to market entry and expanding scope of services.

Design of solid waste and sludge disposal facilities for Proctor and Gamble Paper Company, Philip Morris U.S.A., Federal Cartridge Corporation, Cities Services Company, and several confidential clients.

Evaluation of landfill and concept design of leachate control plan for City of Bethlehem, Pennsylvania.

Evaluation of a landfill and development of a rehabilitation/reconstruction plan for New Castle County, Delaware.

Professional Profile

ONTARIO RESEARCH FOUNDATION

SHERIDAN PARK RESEARCH COMMUNITY
MISSISSAUGA, ONTARIO, CANADA L5K 1B3 • (416) 822-4111 • TELEX 06-982311

DR. ROBERT G.W. LAUGHLIN

Assistant Director, Department of Environmental Chemistry

EDUCATION

B.Sc., Chemical Engineering, 1964, University College, London, England
Ph. D., Chemical Engineering, 1967, University College, London, England

AREAS OF EXPERTISE

Industrial waste utilization and disposal, process economics analyses; research programs management; energy analysis; energy recovery from waste materials.

EXPERIENCE

- Critical reviews of SO_2 and odour control processes.
- Development of SO_2 control process for non-ferrous metal smelters.
- Development and testing of fine-particle control devices for air emissions.
- Development of research programs and analytical techniques for the Ontario Experimental Plant for Resource Recovery.
- Development and application of energy analysis methodology to resource recovery for municipal waste and packaging alternatives.
- Co-ordination of Ontario Research programs in industrial waste utilization.
- Management of Ontario Research programs to develop a wet oxidation technique.
- Study for the Canadian federal government, Department of Energy, Mines and Resources, on "Impact of Partial Substitution of Methanol in Industrial and Automotive Fuels".
- Critical review and recommendation for the establishment of a Canadian Industrial Waste Materials Exchange.
- Operation of the Canadian Waste Materials Exchange for Environment Canada.
- Investigation of energy production from peat using wet air oxidation.

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers of Ontario
Canadian Society for Chemical Engineers
Director, World Association for Solid Waste Transfer and Exchange

ONTARIO RESEARCH FOUNDATION

SHERIDAN PARK RESEARCH COMMUNITY
MISSISSAUGA, ONTARIO, CANADA L5K 1B3 • (416) 822-4111 • TELEX 06-982311

MATTHEW P. McKIM

Associate Research Scientist, Department of Applied Chemistry

EDUCATION

Dip. Tech., Chemical Technology, 1972, Saint John Institute of Technology, New Brunswick
B.Sc., Chemical Engineering, 1977, University of New Brunswick
M. Eng., Environmental Engineering, (Fall 1981), University of New Brunswick

AREAS OF EXPERTISE

Environmental pollution control, product and energy recovery from waste materials; industrial and domestic water and wastewater treatment; industrial fermentation.

EXPERIENCE

- Study for the Canadian Federal Government, Department of the Environment, on "Management of Hazardous Wastes in the Maritime Provinces".
- Process design of industrial and domestic wastewater treatment facilities.
- Evaluation of gasifier performance employing wood and food industry wastes.
- Industrial process design for energy and water conservation.
- Studies on the efficacy of fuel and SCP derived from waste lignocellulose and carbohydrates.
- Computer simulation of industrial processes.
- Computer prediction of contaminant transport.
- Bench scale treatability studies of industrial wastewaters.
- Design and evaluation of bench scale fermentation units.

PROFESSIONAL AFFILIATIONS

Association of Professional Engineers of the Province of Ontario

Pollution Control Association of Ontario

Water Pollution Control Federation

PUBLICATIONS

1.(a) "Evaluation of Secondary Treatment Systems for Treating Potato-Processing Wastewater", A.A. Cocci, M.P. McKim, R.C. Landine and T. Viraraghavan, Agricultural Wastes 2, 273-7 (1980).

(b) "Evaluation of Secondary Treatment Systems for Treating Potato Processing Wastewater at McCain Foods Limited, Florenceville, New Brunswick". A.A. Cocci, M.P. McKim, R.C. Landine and T. Viragavahan. Presented at the 1979 CSCE Conference, Montreal, P.Q., June 1979.

2. "Combined Aerobic-Anaerobic Treatment Produces Low Cost, Quality Effluent", M.P. McKim, A.A. Cocci, T. Virarghavan and R.C. Landine, Industrial Wastes May/June 1979, pp 53-5.

3. "Hazardous Wastes Management in Canada". G.B. Ward (University of New Brunswick) and M.P. McKim. Proceedings of the 1981 CSCE Conference, Fredericton, N.B., May 26/27, 1981.

4. "Treatment and Disposal of Hazardous Wastes". Presented at the 64th Annual Conference of the Chemical Institute of Canada, Halifax, N.S., July 1981.

Michael H. Corbin, P.E.

Registration

Registered Professional Engineer in the Commonwealth of Virginia

Fields of Competence

Solid waste and hazardous waste management including disposal, collection, storage, transfer, shredding, and resource recovery; industrial waste disposal and sludge management; disposal facility design and permiting.

Experience Summary

Eight years of diversified engineering and operational experience in the field of solid waste management including interaction with regulatory agencies, optimization of industrial waste systems, handling of hazardous wastes, and disposal-site evaluation.

Credentials

B.S. Mechanical Engineering — University of Virginia (1970)

M.S. Mechanical Engineering — Massachusetts Institute of Technology (1972)

Tau Beta Pi

Sigma Xi

Employment History

1976-Present	Weston
1972-1976	County of Fairfax, Virginia Engineer
1970-1972	Massachusetts Institute of Technology Research Assistant

Key Projects

Served as Project Engineer for the following Weston solid-waste management projects:

- Development of a plant-wide solid waste management system and design for upgrading an existing on-site landfill for a major iron and steel production facility in Pennsylvania.
- Design of a secure land disposal facility and development of a waste handling program for a New Jersey metals processor.
- Preparation of the Hazardous Waste Management Plan for the State of Alabama.
- Optimization of an industrial waste handling and disposal system for a major West Virginia chemical firm.
- Design of a secure land disposal facility for a major New Jersey hazardous waste processor.
- Preparation of an industrial and hazardous waste management plan for a major Texas chemical firm.
- Evaluation of the suitability for land disposal of process sludges generated by a Pennsylvania chemical/pharmecutical firm.
- Evaluation of refuse collection alternatives for a PUD community in New Jersey.
- Preparation of a 208 Residuals Plan for Erie/Niagara Counties, New York.

As Deputy Director of the Division of Solid Waste for the County of Fairfax, Virginia, was responsible for the collection and disposal of all solid waste generated in the County (population 550,000), including the operation of a 1,500-ton/day sanitary landfill and a 40-vehicle collection fleet. Also participated in the planning, implementation, and administration of a regional solid waste disposal and resource recovery complex.

As an Engineer in the Wastewater Treatment Division for the County of Fairfax, was responsible for the operation of nine sewage treatment plants, including sludge handling and disposal systems.

As a Research Assistant, at MIT co-supervised the development and construction of a Vortex Classifier designed to sort shredded municipal refuse for recycling.

Publications/Technical Papers

"Industrial Solid Waste Containment: Upgrading Existing Landfills," by M.H. Corbin and W.H. Porter.

"Management Aspects of Potentially Hazardous and Special Wastes," by M.H. Corbin, A.A. Metry, and K.M. Peil.

"Multi-Media Environmental Impacts of Residual Waste Management," by A.A. Metry, M.H. Corbin, B. Tencer, and K.E. Patterson.

Professional Profile